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Association Between Body Mass Index And Depression On Hbaic Control Among Veterans

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
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Walden University
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Abstract

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MSN, St Xavier University, 2012

BSN, Framingham State University, 2006

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

The study investigated the association between body mass index (BMI) and depression based upon glycated hemoglobin levels (HBA1C) among United States veterans. Based on Bandura's social cognitive theory, a cross-sectional analysis examined the association between BMI and depression on HBA1C regulation, and if the interaction between BMI and depression affects HBAIC regulation among veterans. Multiple regression analysis was used to test the multivariate associations between depression and BMI on the outcome variable of HBA1C. Linearity, normality, and homoscedasticity were assessed using normal probability plots and residual analysis. Durbin-Watson statistics were used to test for autocorrelations, and variance inflation factor was used to check for multicollinearity. There was not a statistically significant difference between those who were depressed (*Mdn* = 32.76, *IQR* = 7.8) and those who were not depressed (*Mdn* = 33.27, *IQR* = 5.0) in terms of BMI (U = 774.0, p = 0.47). When depression, BMI, an interaction term for depression*BMI, and other predictor variables were entered into the regression model, these variables did not account for a significant increase in shared variance in A1C ($\Delta R2$ = 0.17, F (14, 74) = 0.17, p = 0.37). Social change implications generated from this study include better resource utilization, improved quality of care, increased veteran satisfaction and improved veteran experience across the healthcare system. The findings from the study can be used to expand access to specialized services for chronically ill veterans, coordinate resources, better outcomes and facilitate seamless care coordination between mental health and primary care providers.

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Dedication

I dedicate my research to my dear husband, Fred Osei-Yeboah and my four lads, Jared Bernard Addo, Kwesi Yeboah, Kwabena Osei-Yeboah, and Kofi Osei-Yeboah. To my siblings, Akosua McDonald and Nyantakyiwa Buotu for your encouragement, during the times I wanted to quit you encouraged me to press on, letting me know I can accomplish this goal. Also to my aging parents, Benjamin and Matilda Asare Buotu, both of whom have been waiting to see me graduate, through the emotional ups and downs, you assured me to rely my strength onto God, for he will see me through and he did! This journey was accomplished with the support and encouragement from all of you. I owe this accomplishment to all of you from the bottom of my heart.

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The journey to this great accomplishment seemed never-ending, with mixed feelings on how to survive the stress of school. Many days I felt like this was not achievable due to the amount of commitment needed to balance school, family life, and work. But I know God's ways are the best, and his plans for us never fail. The very first thank you goes to God Almighty. With God all things are possible, and without his protection, this milestone would have been impossible to complete. The book of Philippians 4:13 says "I can do all things through Christ who strengthens me." May his name be glorified? I give him all the thanks, praise, and adoration.

Second, I salute my husband Mr. Fred Osei-Yeboah who is my number fan, I wouldn't have made it without his help and support. His words always echoed "you are almost at the end you can do this!" Balancing four active boys who are involved in sports could not have been more challenging. However, my husband stepped in and ensured things get done promptly.

Third, my dissertation committee chair, Dr. Egondu Onyejekwe, for sharing her knowledge and expertise in helping me narrow my research question and guiding me through each step. Dr. Xiaban Li, first committee chair member, for reviewing the data analysis multiple times to ensure accuracy, Dr. Donna Clews, University Research Reviewer for her guidance, Dr. Tammy Root, Academic Research Coordinator for her support, and Dr. Rea, Program Director for words of encouragement. Also, to Dr. Howard Gordon at the Department of Veterans Affairs for being a mentor and helping me obtain the study database. Finally, to Pastor Pokoo at Lifetouch Worship Center, for his prayers and kind words of encouragement throughout the school year.

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Section 1: Foundation of the Study and Literature Review

Introduction

According to a detailed report by the American diabetes association (ADA), diabetes mellitus (DM) (2018) is listed to be the seventh leading cause of death in the United States (U.S.) with a significant impact on health outcomes. According to Rowley, Bezold & Krohe (2017), the projected prevalence of DM in the U.S has reached alarming proportions with an expected projection that number will rise by 54% of the U.S. population to greater than 54.9 million people by the year 2030. The total cost to treat the population diagnosed with diabetes in the year 2012 was $245 billion, that figure however, had risen to 327 billion in 2017 of which $237 billion originated from direct medical costs and the other 90 billion, from reduced productivity (ADA, 2018).

Tuomilehto et al. (2001) stated, diabetes pathogenesis is characterized by genetic susceptibility along with modifiable behavior and environmental risk factors such as obesity and sedentary lifestyles. My review of extant literature produced several epidemiologic studies that supported the active role of physical activity and how it can avert obesity and diabetes mellitus type II (DM type II). Hu (2003), found that some of the primary reasons known to drive the prevalence of DM type II are obesity and inactive lifestyles, such as many hours spent watching television and poor dietary habits. Obesity is listed as one of the critical public health concerns; a significant risk factor for diabetes, high blood pressure, and heart disease (Pi-Sunyer, 2009).

A body mass index (BMI) of higher than 30kg/m2, defines obesity. BMI is used to calculate an individual's weight in proportion to height to confirm the presence of excess body fat and to determine if a person is obese, overweight or underweight (Flegal & Graubard, 2009). As a result, BMI is recognized to be an essential measurement that identifies patients who are susceptible to poor health outcomes which result from obesity (Djalalinia, Qorbani, Peykari, & Kelishadi, 2015) Worldwide, obesity claims about three million lives annually, poses a significand health burden, drives health care expenditure, impacts quality of life and causes multiple chronic health problems (Djalalinia et. al 2015). In further support of the role obesity plays to the diabetic epidemic, (Hurt, Kulisek, Buchanan, and McClave (2010) reported that obesity is a huge medical challenge for providers with severe comorbidities, economic and health repercussions. Similarly, (Djalalinia et al. 2015) publicized that obesity drives serious health repercussions, is burdensome to healthcare systems, and is a critical risk factor for metabolic disorders, especially DM II, a focus of this doctoral study.

Andreoulakis, Hyphantis, Kandylis, & Iacovides (2012), reported people who have been diagnosed with diabetes are at increased risk for persistent or recurrent depression. When depression and diabetes co-occur health outcomes and or quality of life are significantly impacted, clinical deterioration persists and mortality is increased. One of the critical symptoms of major depression is a decreased interest in doing things, fatigued loss of energy, appetite changes and in some cases, individuals become suicidal and or commit suicide (Badescu et al., 2016). Depressed patients who suffer from DM type II clinically present with poor blood sugar control, poor eating habits, decreased physical activity due to fatigue, poor self-management therefore the risk of diabetes related complications are heightened (Badescu et al., 2016). This overwhelming evidence warrants an understanding of the pathophysiology of DM type II, the crucial role of obesity, and how individuals manage diabetes in the wake of depression. With this knowledge, appropriate strategies can be implemented to control this epidemic and improve the health of the population (Schafer, Machicao, Fritsche, & Haring, 2011).

Among veteran's, diabetes is listed as the third most prevalent diagnosis, consuming an enormous amount of healthcare resources (Reiber, Koepsell, Maynard, Haas, & Boyko, 2004). In 2011, the Veterans Affairs (VA) primary care clinics across the nation reported 24.4% of their veterans had diagnosed diabetes, 52.3% hypertension, and another 36.6% were diagnosed with obesity (Cully et al., 2014). Over the years, obesity has been established as the Number 1 risk factor to diabetes with supporting evidence from the ADA (2014) showing that being obese predisposes an individual to some level of insulin resistance. Even though, a significant proportion of DM type II patients are obese which has contributed to the growing incidence and prevalence rates of diabetes over the last two decades (Ecke, Robert, Kahn, Steven, & Smith, 2011). Conversely, depression is a common comorbidity noted among persons who suffer from chronic conditions, and this added burden makes it difficult for patients to manage and or perform self-care activities for better health (Berge, Rilse, Tell, Iverson, Ostbye, Lund & Knudsen 2015; Vogelzangs, Kritchevsky, Beekman, Brenes, Newman, Satterfield, Penninx 2010).

In this doctoral study, I aimed to gain an understanding of the unique association between BMI and depression on a veteran's ability to control diabetes. Using the results from this study, I will make recommendations to place particular emphasis on resource utilization that will improve care coordination between mental health practitioners and primary care providers to better the health of veteran's.

Problem Statement

The VA is known as one of the largest healthcare organizations in the country and operates approximately 1,240 facilities nationwide with services to over nine million veterans (Veterans Health Administration, 2018). In a review of several veteran medical records Olenick, Flowers, and Diaz (2015) indicated that one in three veterans suffer from at least one mental health disorder. Other veteran's often suffer from substance abuse disorders, traumatic brain injuries, chronic pain, and homelessness. According to Kinsinger (2015), the VA health system has witnessed a considerable number of veterans who bear a high burden of chronic diseases. Out of about 6 million veterans that used primary care services in 2011, 36.7% were obese, 52.3% had high blood pressure, 24.4% were diabetic, 16.1% had ischemic heart disease, and another 8.4% has a chronic obstructive pulmonary disease (Kinsinger, 2015). These figures stand higher among veterans than the national averages of the U.S. population (Kinsinger, 2015).

With this knowledge, it is evident that the VA health system faces significant healthcare challenges including extensive resource utilization and the quest to improve poor outcomes which stem from chronic diseases (Del Re, Maciejewski, & Harris, 2013).

Franklin, Rajan, Tseng, and Sinha (2014) disclosed that one in four veterans suffers from diabetes which places a significant burden on the healthcare costs of the VA and dramatically reduces the quality of life for the veterans. Regarding obesity, the office of Research and Development (2016), a research branch of the VA, reported about 165,000 veterans have a BMI of greater than 40. The National Institute of Health (NIH, 2017) has specific classifications for BMI, where a person with a BMI of between 18.5 and 25 is considered healthy, 25 to 29.9 overweight, 30 to 39.9 obese, and > 40 extremely obese or morbid obesity; a dangerous health condition (NIH, 2017; U.S Department of VA, Office of Research & Development (R&D), 2016).

Obesity and severe obesity puts a person at very high risk for diabetes hypertension and cardiovascular disease (NIH, 2017). The obesity epidemic is particularly concerning among veteran's post deployment because weight gain is known to be evident (Breland et.al 2017). The obesity pattern has also been witnessed as veterans grow older, and this is especially significant because veterans contribute to the considerable portion of the population of the United States (Maguen et al., 2013). When an individual harbors DM type II, the beta cells cannot secrete enough insulin to counterbalance insulin resistance, and insulin resistance is known to derive from environmental determinants including obesity (Schafer et al., 2011).

Various research studies have improved our understanding of the association between obesity and depression, arriving at similar conclusions that possession of multiple chronic conditions contribute to disabling health (Vogelzangs et al., 2010).

Several studies (Bajaj, Agarwal, Varma. & Singh 2012; Berge and Riise 2015 and Fiore et al. 2015) confirmed that the association between diabetes and depression produces adverse and debilitating effects; consequently, a person may experience a more inferior quality of life because of poor self-care practices and medication noncompliance. De la Cruz-Cano et al. (2015) studied the association between obesity and depression in patients with DM II with a focus on determining whether being obese increased an individual's risk for depression in the setting of DM type II. Despite established information detailing that the combination of depression, obesity, and diabetes produces poor health outcomes, my review of the literature produced limited cross-sectional studies that had examined the association between obesity and depression on glycemic control among veterans.

Purpose of the Study

In this study, I investigated the association between BMI and depression to determine whether this association affects HBA1C regulation among veterans with DM type II diabetes using a sample of veterans from the VA healthcare system. The study results will perfect our current understanding of the complexity of managing multiple chronic illnesses and to better understand whether the relationship between BMI and depression contribute to uncontrolled diabetes among veterans. By understanding this association, multidisciplinary collaboration, and care interventions can be coordinated to achieve improvements in target health outcomes, improve quality of life and decrease excessive healthcare spending within the Veterans Health Administration.

Nature of the Study

The study was quantitative, with secondary data analysis. A cross-sectional design with review of electronic medical records was utilized. To confirm the presence of depression, I will review the veteran's medical records for the results of a positive or negative Patient Health Questioanaie-2 (PHQ-2) screen: a measure of depressive symptoms and anhedonia over a 2 week period (NIH, 2017). In this study, I will discuss HBAIC, a serum blood level that serves as a measure of blood sugar regulation over a 3month period, BMI and weight. I hypothesized that a veteran with a BMI > 30 and a HBA1C > 7.5 is depressed, and therefore, unable to regulate their diabetes.

Research Questions and Hypothesis

I developed the following research questions and hypotheses to guide this study:

RQ1: Is there an association between BMI and depression among veterans?

$H_0$1: There is no association between BMI and depression.

$H_1$1: There is an association between BMI and depression.

RQ2: Does the interaction between BMI and depression predict HBA1C regulation among veterans?

$H_0$2: The interaction between BMI and depression does not predict HBA1C regulation among veterans

$H_1$2: The interaction between BMI and depression predicts HBA1C regulation among veterans.

Theoretical Framework

Diabetes management requires the patient to maintain a healthy diet, control their weight, adhere to their medication, engage in physical activity, monitor blood glucose, reduce stress, and keep regular medical appointments (Adejoh, 2016). Being able to perform the actions mentioned in the preceding sentence remains a challenge for diagnosed individuals because it requires a change in their behavior. According to Green (2000) human behavior is complex because human behavior can be influenced by the environment. Both the environment and human behavior are determinants of an individual's health, and changing individual or group behavior can be challenging (Green, 2000). For change to be active and sustained, researchers have proposed various health theories as well as social and behavioral sciences to understand the questions why, what, and how. Theories are useful in predicting health behavior and to effectively arrange and appraise interventions (Green, 2000).

The theoretical framework that I selected for this study was the social cognitive theory (SCT), an epistemological work of Albert Bandura (1986). The SCT details that the way in which humans behave can be envisioned based on reciprocal and dynamic influence of personal factors, behavior and environment (Bandura, 1986). According to Bandura, personal elements, environmental conditions, behavior, and cognition all operate together reciprocally as factors affecting each other in opposite directions. SCT emphasizes three key factors that affect the probability that an individual would change their health behavior: self-efficacy, goals, and outcome expectancies (Bandura, 1986).

When a person possesses a sense of personal control over a health behavior, they are optimistic to change, even amidst barriers (Bandura, 1986). SCT has three critical facets of utmost relevance: the development of skills through skilled exemplars, the empowerment of individual beliefs in their ability to promote the use of talent, and the improvement self-motivation through target systems (Bandura, 1989).

The concept of self-efficacy beliefs serves as a crucial factor which can contribute or impede an individual's motivation, actions, and affect (Bandura, 1988, 1989). The cognitive process of self-efficacy beliefs iterates when an individual possesses a solid self-efficacy, they are more apt to set higher goals for themselves and are more likely to ensure goal attainment (Bandura 1988). For this study, the concept of self-efficacy enabled me to understand how a person's perception of their self-efficacy can influence their self-worth and induce their motivation to participate in various health activities (Bandura, 1988, 1989).

Operational Definitions

Body mass index (BMI): According to the NIH Heart Lung and Blood Institute (DATE), BMI, including waist circumference, is used to screen and confirm the diagnosis of overweight/obesity; a severe medical condition. NIH (2017) furthers stated that in the adult population, a BMI between 18.5 and 25 is considered healthy, 25 to 29.9 overweight, 30 to 39 obese, and > 40 extremely obese. Evidence confirmed that high body fat poses a risk for metabolic diseases, especially DM type II and high cholesterol, and a majority of patients with diabetes are either overweight or obese (Bays, Chapman, & Grady, 2007).

Depression: According to The NIH (2017, depression is relatively prevalent significant mood disorder that affects an individual's thought process diagnosed based on persistent symptoms for a minimum of 2 weeks (NIH, 2017). Depression causes severe symptoms that interfere with feelings, thoughts, work, sleep, eating patterns, and the ability to manage activities of daily living.

Hemoglobin A1C (HBA1C): A blood test that fundamentally discloses the average blood sugar level over a three-month period used to diagnose DM type II. The HBA1C standards are used by providers to track and monitor how patients control diabetes. With the HBA1C, providers ensure patients meet treatment goals and medications are adjusted per the HBA1C level so that diabetes-related complications are reduced (NIH, 2017). The NIH categorizes A1C in three different levels. Normal HBA1C is rated below the level of 5.7%; however, with consistent levels above 6.5%, an individual stands the risk of being diagnosed with diabetes (NIH, 2017). A1C levels of 8 or higher generate an estimated blood glucose levels of > 180 subsequently known to produce adverse complications which include effect mood swings and poor sleep (Czech, Orsillo, Pirraglia, English, & Connell, 2015).

Veteran: According to Title 38 of the Code of Federal Regulations, a veteran is an individual that served in the active military, U.S. Navy, or U.S. Air Force and other military branches and was released or discharged honorably (VA, 2016)

Assumptions

In this study, I used the dataset gathered to investigate the association between BMI and depression on HBA1C levels. Using a cross-sectional survey design and based on the research questions, I made the following assumptions:

- Depression alters a veteran's ability to manage their diabetes.
- Overweight veterans are depressed, and therefore, unable to control their diabetes.
- Elevated BMI and depression do not affect a veteran's blood sugar level.
- Veterans do not understand the importance of weight management and blood sugar control.

Limitations

I identified a few limitations. First, I conducted the study among the veteran population, so the results can only be generalized to veterans and not to the general population. The second limitation was the use of convenient sampling from a database of diabetic veterans at one particular VA hospital in an urban area. Another limitation was the use of cross-sectional survey design. The use of cross sectional study design allows me to perform a quick and cost effective analysis, and to evaluate more than one outcome. Some of the limitations are the fact that data gathered on the study participants, are recorded one time, therefore association may be deduced but causation cannot be established (Sedgwick, 2014).

Scope and Delimitations

In this study, I drew on secondary datasets of the veteran diabetic population. The database was made available from the VA Office of R&D. The focus of this study was to understand the association between BMI and depression and whether this association affects blood glucose regulation. Other diseases that resulted from military service were excluded.

The Significance of the Study

One of the crucial risk factors for diabetes is obesity (Pi-Sunyer, 2009). Depression is also a common comorbidity noted among persons who suffer from chronic conditions (Berge et al., 2015; Vogelzangs et al., 2010). Among the veteran population, nearly one in four has diabetes which, therefore, places a significant burden on healthcare costs and quality of life (Franklin et al., 2014). According to the National Center for Veterans Analysis and Statistics (2015), about 92% of veterans are men with a median age of 65 years. The growing population of veterans is estimated at over 20 million, and are known to seek healthcare services from other healthcare agencies outside of the VA (National Center for Veterans Analysis and Statistics, 2015). The predominantly male population of veterans becomes particularly important when looking at various health issues and other economic equations because there is that probability that sex difference are exaggerated.

It is imperative to understand that the United States veteran population is a unique population with a variety of wartime service eras from the Vietnam War to

Operation Iraqi Freedom. This variety of veterans based on their period of service presents healthcare providers with specific health issues. However, mental health seems to be the most common diagnosis with 1 out of every 3 veterans possessing a mental health disorder, most often depression (Olenick et al., 2015). In this study, I aimed to gain an understanding of the unique association between BMI and depression on a veteran's ability to control diabetes. What I learn from this study can be used to place particular emphasis on resource utilization and improve care coordination for veterans to achieve glycemic goals.

Social Change Contribution

The results of this study will impact social change positively concerning veterans' health because when the health of the veteran population is improved, there can be the potential reduction in other health factors such as high blood pressure, cardiovascular disease, hypocholesteremia, and some forms of cancer. When their health is improved, their health outcomes are ultimately enhanced and the economic costs are decreased in the VA healthcare system (De la Cruz-Cano et al., 2015; Green, Branchi, & Albright, 2012). Also, the VA organization will reap cost-saving benefits when health care reform is pushing for integrated primary care with a team of providers working together to manage the unique needs of patients.

Summary and Transition

Diabetes is the fundamental cause of mortality and morbidity in the nation. According to Marx (2013), in 2007, the cost to treat diabetes was estimated at $174 billion and that figure has since increased to $245 billion by 2012. These prices include a loss of productivity and healthcare resource utilization. Over decades, diagnosed diabetes prevalence has risen among the U.S. population from 3.5% in 1990 to 7.9% in 2008, before remaining steady between the years 2008–2012 (Curtis, Kothari, Paul, & Connors, 2013). The yearly rates of diabetes is on the rise, especially among adults who harbor about 95% of Type 2 diabetic cases (Curtis et, al. 2013; Marx, 2013).

Given the obesity rates of veterans as well as the high prevalence of diabetes, there is a concern for their poor health outcomes, which led to this study focusing on providers who work with veterans to develop successful strategies. Developing successful strategies to reduce diabetes prevalence in this study included identifying veterans who are a high risk of obesity, veterans with depressive symptoms, and veterans who demonstrate the inability to regulate their A1C and making the appropriate referrals. The results from this study provide a valuable contribution that extends the understanding of how to create successful interventions to include collaborative effort between primary care and mental health practitioners to better the health of veterans.

Review of Literature

For this study, I conducted a thorough literature review. In the first subsection of the literature review, I will address obesity and obesity-related health outcomes, while in the second, I will discuss depression and how it affects the management of chronic illness. The third subsection will include a discussion of diabetes and its related health outcomes while the fourth contains the health outcomes of the veteran population and how obesity diabetes and depression and priority areas for the VHA system. I will end the section with a presentation of the study variables, study methodology to explore the variables, and the gap in the literature regarding the association between BMI and depression. Accessed through the Walden University Library, I used several databases and search engines to search for published, peer-reviewed articles: CINAHL, Google Scholar, PubMed, PsycINFO, Sage, OVID, Academic Premier, Science Direct, Medline, and PubMed Central. The keywords I used for the search included *obesity, depression, diabetes, chronic illness, veteran's health, Veterans Healthcare System priority health focus, complications of chronic diseases, patient health questionnaire tool to screen for depression, diabetes and depression* and *healthcare spending.*

Obesity and Obesity-Related Health Outcomes

The CDC (2017) defined BMI of 30 or higher as obese, which equates to a person being 30 lbs. overweight. BMI is a description of the percentage of body fat concerning weight and height (CDC, 2017). The calculation of BMI is as follows: weight (lbs.)/height (inches) squared x 703 (CDC, 2017). In general, individuals who are obese stand the risk for many adverse health conditions and diseases compared to individuals without obesity, including hypertension, DM type II, and coronary artery diseases (CDC, 2017). According to the NIH (2013), approximately 78 million adults are obese, which signals a significant public health problem (NIH, 2013). The obesity trend further reveals 90% of people with diagnosed with diabetes are typically overweight and that number is expected to increase (Obesity Society, 2015).

Table, 1.

Obesity

Weight	Obesity class	BMI(kg/m2)
Underweight		<18.5 -24.9
Normal		25.0-29.9
Overweight	I	30.0-34.9
Obesity	II	35.0-39.9
Extreme Obesity	III	$\geq$ 40

According to Hurt et al. (2010), in the last three decades, the United States has witnessed an increased incidence of obesity rates among the adult population to an alarming rate of 60%. As a result, doctors encounter significant challenges to providing healthcare resulting in an enormous amount of healthcare resources needed to treat obesity-related health conditions. The estimated cost to treat obesity is approximately $150 billion annually, notwithstanding the high mortality and morbidity rates (Hurt et al., 2010).

According to Selassie and Sinha (2011), a significant proportion of the population in the United States is overweight, whereas a third are obese. This problem is even more evident within developing countries and continues to grow; hence, driving the trend to epidemic proportions as being witnessed with the subsequent massive burden on healthcare systems (Selasie & Sinha, 2011). The authors further mentioned that the factors contributing to the current trend are the environment; foods rich in calories; decreased physical activity; and the availability of technology, whereby time is spent watching television and technology used to assist with many household duties (Selassie & Sinha, 2011). Herrera, & Lindgren (2010) argued obesity is a disease that originates from energy variance that depicts the intake of energy is higher than the consumed; hence, the net result is weight gain. Evidence from the last 20 to 30 years has shown that the annual weight gain of the adult U.S population is about 0.5kg to 1 kg (Herrera & Lindgren, 2010).

Extensive research has revealed the correlation between an individual's risk for obesity and genetic and biological factors. Specific genes linked to the risk of obesity include peroxisome proliferator-activator receptor-y gene and prohormone con-vertase-1 gene (Selassie & Sinha, 2011). Of utmost relevance is the role of the environment in obesity. In recent years, the considerable portion serving size in restaurants, beverages with high sugar content, and high fatty foods seem to be prevalent in communities (Selassie & Sinha, 2011). This dietary pattern and consumption of caloric dense foods has contributed to the rise in the obesity rates (Benton, 2015; Selassie & Sinha, 2011).

Mokdad, Ford, and Bowman (2003) publicized that obesity and diabetes are one of the critical causes of mortality and morbidity in the United States. Mokdad et al. used the Behavior Risk Factor Surveillance System to analyze the association between obesity and crucial various health risk factors and revealed the significant association between obesity, hypertension, asthma, arthritis, diabetes, high cholesterol, and poor health conditions.

Wang, Beydon, Liang, Caballero, & Kumanyika (2008) reported obesity is burdensome to society, notwithstanding the social, psychological, and health consequences faced by obese individuals. Obesity impacts life expectancy and drives healthcare costs in the billions. The CDC (2017) estimated obesity related medical expenditures for the year 2008 at $147 billion are attributed to obesity-related medical expenditures and that figure will continue to rise as the prevalence rates increases. The obesity-related spending comes from both direct and indirect costs with direct costs including preventative care, diagnostics, and treatments, all of which result in loss of productivity due to limited activity (CDC, 2017: Wang et al., 2008). Indirect costs involve morbidity and mortality to loss of income from premature death (Wang et al., 2008).

Obesity

As I previously mentioned, one of the critical public health concerns in the United States is obesity because it is a significant risk factor for diabetes, high blood pressure, and heart disease (Pi-Sunyer, 2009, Hurtet et al., 2010). Both men and women are at risk for and considered obese if they display a BMI of higher than 30kg/m2 (CDC, 2017). As a result, BMI is known as an essential measurement to identify patients who are susceptible to obesity-related poor health outcomes (Klien et al., 2007). According to Klien et al. (2007), the projected obesity-related direct healthcare costs will double every 10 years, and by 2030, the costs are estimated to be more than $950 billion, which accounts for about 17% of average healthcare expenditure. Every year, over 300,000 deaths are caused by obesity, a rate almost as high as cigarette smoking, which causes about 400,000 deaths a year (Klien et al., 2007). Obesity is known to be controlled and prevented by engaging in physical activity and changing behavior; some other ways to modify behavior to combat obesity include improving dietary habits, being physically active, and setting goals that are achievable to reduce weight loss (Obesity Action Coalition, 2018).

Diabetes Mellitus (DM)

The CDC (2012) defined diabetes as a disease where serum blood glucose levels are above average. In simple terms, the human body cannot make or metabolize insulin; therefore, sugar builds up in the bloodstream causing adverse health (CDC, 2012). Among the Top 10 leading causes of death and disability in the United States, diabetes ranks seventh (CDC, 2012). The American diabetes association (2018), reported over 75,00 deaths in 2015 were attributed to diabetes. This figure excludes the long-term health damage of diabetes and costs involved to sustain life and reduced productivity (ADA, 2018). The CDC (2007) estimated that the direct medical cost to treat diabetes was $116 billion and another $58 billion was spent to treat diabetes-related complications. In the year 2010, the CDC (2012) reported individuals over 20 years of age comprised 1.9 million of the people diagnosed with diabetes (CDC, 2012). However, the highest number of each new case diagnosed among the population were in the age group of 45–64 years old (CDC, 2012).

The ADA (2017) has four different classifications and diagnosis of diabetes namely, diabetes Type 1; diabetes Type 2; other specific types such as genetic defects, a disease of the pancreas; and gestational diabetes (ADA, 2017). Prediabetes is when a person's blood sugar is slightly higher than average levels, yet not high enough to be diagnosed as diabetic (ADA, 2017). A review of the literature reveal prediabetes can cause damage to the heart, specifically heart attack and renal system. The symptoms are masked, with long term consequences such as heart and kidney damage, when left untreated, prediabetes can progress to DM type II (ADA, 2017). In the prediabetes stage, there are chances for the individual to lower their risk of diabetes when they engage in physical activity and other weight loss initiatives that include the target of losing 7% of their body weight (ADA, 2017).

The ADA's (2017) first classification is known as diabetes Type 1 or insulin-dependent diabetes, prevalent among children and young adults. According to researchers, Type 1 diabetes is attributed to possible environmental factors and results from a virus that attacks the immune system causing an attack on the beta cells of the pancreas (ADA, 2017). Therefore, the body does not make any insulin and the individual diagnosed becomes insulin dependent (ADA, 2017; CDC, 2012). DM II accounts for approximately 90%–95% of diabetic cases (ADA, 2017) and affects the body's ability to produce enough insulin (ADA, 2017). DM II disproportionately affects African Americans, Asian Americans, Latinos, Native Hawaiians, and other Pacific Islanders as well as the elderly (ADA, 2017, p. 1; Office of Minority Health, 2016).

Gestational diabetes occurs around 24 weeks of gestation when the mother is unable to make and absorb the insulin needed for the duration of the pregnancy (ADA, 2017. Overall, the risk factors to develop diabetes are age 45 or higher are strong family history, hypertension, hypocholesteremia, an episode of gestational diabetes, physical inactivity, and obesity (ADA, 2017). Other types of diabetes are known to originate from pancreatic disorders and/or are drug- induced, such as taking steroids to treat other diseases (ADA, 2017)

DM is known as one of the most complex progressive metabolic disorders, affecting over 382 million people globally and is a known contributor to microvascular and macrovascular diseases that affect various organs, mainly the eyes, kidneys, cardiovascular system, and nerves (Zaccardi, Webb, Yates, & Davies, 2016). The classic microvascular complications include damage to the retina, dysfunction of the peripheral nerves, and kidney damage, whereas heart disease, peripheral vascular disease, and stroke constitute microvascular complications (Zaccardi et al.). As the peripheral vascular disease progresses, an individual becomes susceptible to non-healing wounds which can further lead to lower extremity amputations (Deshpande, Haris-Haynes, & Shootman, 2008).

The clinical manifestations of DM are hyperglycemia. Once diagnosed, individuals, demonstrate the simultaneous existence of insulin resistance and B-cell disorder due to the body's immune activation against B-cells (Cornell, 2015; Zaccardi et al., 2016). Other related pathophysiological processes accompanying impaired insulin is the body's inability to respond to insulin cells hence, causing hyperglycemia. This hyperglycemia state further results in clinical symptoms such as weight loss, weakness, frequent urination (polyuria), and excessive thirst (Seph et al., 2015).

According to the (CDC, 2012), the rates of DM has climaxed, reaching epidemic proportions in the United States. Similarly, there is a rise in the incidence rates of diabetic patients who have an end-stage renal disease; the leading chronic disease caused by diabetes. Nonetheless, the disease, DM, has many significant complications stemming from blindness to lower extremity amputations and a major contributory factor to stroke and heart disease. As previously mentioned, diabetes is rated the seventh leading cause of mortality in the United States alone and afflicting over 20 million people. Each year, over $130 billion is spent to treat diabetes-related medical conditions factored in this figure are indirect costs from untimely death and disability (ADA, 2014; Miller & Pogach, 2008; Selph et al., 2015).

Veterans and the Prevalence of Diabetes

Veterans are comprised of diverse background and referred to as a group with a distinct culture. The culture whereas military engrained includes teamwork, values, customs, identity rank, hierarchy and standards of behavior (Olenick et al 2015).

Nonetheless, various military service and war era produces multiple experiences which include specific health issues. For instance, Operation Endurance Freedom and Operation Iraqi Freedom (OEF/OIF) veterans are a younger population more socially integrated compared to veterans who served in the Vietnam Era and the Persian Gulf. Review of literature found that, 75% of OEF/OIF population were notably obese and or overweight, and so are faced with the equal risk of hypertension, diabetes and cardiac disease (Maguen et al.,2013; Olenick et al, 2015).

Mental Health and Obesity

In the United States, veterans are considered a significant proportion of the adult population an estimated population of 23.1 million as documented in the year 2009 (Koepsell et al., 2012). A review of literature from various studies reveal approximately 1 in 3 patients have a diagnosis of at least one mental health disorder. Also, there is evidence that obesity is an epidemic among veterans as disclosed from results from national telephone survey generated from the 1999-2008 National Health and Nutrition Examination Survey (NHANES). This obesity epidemic has been evident mainly post-deployment because of poor dietary habits and because of aging (Kopesell et al. 2012; Olenick et al. 2015).

In a quantitative study by Wiltink et al. (2013), the researchers mentioned that abdominal obesity is a crucial risk factor for both cardiovascular and metabolic diseases compared to obesity. Similarly, Koepsell, et al. (2012) referenced that veterans possess a higher waist circumference compared to the general population. A waist circumference of greater than 80cm in women and more elevated than 94cm in men increases the risk of insulin resistance (Gierach, Gierrach, Ewertowska, Arndt, & Junik, 2014).

Both depression and diabetes are known to cause a substantial burden on the healthcare system and become burdensome for patients. An estimated 24% of patients who have diabetes have a higher chance of developing depression. Consequently, with the diagnosis of depression, the risk for diabetes is heightened. When patients are depressed, self-efficacy is impacted whereby poor self-care practices is witnessed such as dietary noncompliance, lack of exercise and poor sugar regulation is witnessed (Gonzalez et al. 2007). With this background knowledge, there is a need for joint efforts between mental health providers and medical providers to join efforts.

One of the most burdensome significant public health concerns is the complexity and prevalence of depression and obesity. An estimated 10% of the United States population suffers from depression yearly. Consequently, the obesity values have risen to 30% hence proves the magnitude of the issue as it leads to poor health outcomes such as diabetes and heart disease (Afari et al., 2010). Review of literature revealed many studies that examined the association between obesity, weight gain, and depression with different conclusions. For instance, McCrea, Berger, and King (2012) in a quantitative study examined the relationship between BMI and mental health disorders. The study reported that BMI is associated with prevalent mental health disorders; however, the association was known to vary with age. Similarly, Sacks-Ericsson et al. (2007) examined the association between BMI and succeeding depressive symptoms among adults residing in the five counties of North Carolina over 65 years. The study concluded that BMI, predicted depressive symptoms, more so higher among African Americans compared to Whites.

Contrary to the findings of Sacks-Ericsson et al. (2007), a study by Forman-Hoffman et al., (2007) discovered in a prospective study conducted in over 9,000 people age 53-63 that increased weight did not produce depressive symptoms. Instead, weight loss led to increased depressive symptoms in used of unadjusted modes among men *(OR* = 1.26, 95% *CI* = 1.04 -1.53). Increased symptoms of depression although did not predict weight loss, predicted subsequent weight gain in men only models that were unadjusted (*OR* = 1.24, 95% *CI* = 1.00 - 1.54) Women (*OR* =1.12, 95% *CI* = 1.00-1.26); Forman-Hoffman et al., 2007).

Not surprisingly a systematic review and meta-analysis conducted by De Wit et al. (2010) in a longitudinal study, examined the association between depression and obesity to ascertain factors that might be of influence. The researcher's confirmed a complimentary association between depression and obesity. Obesity was noted to increase an individual's susceptible to depression, and depression noted to be a risk factor for obesity. The overall unadjusted OR were tabulated among 15 studies included in the review (*N* = 58,745). Obesity increases the likelihood of being depressed at follow up; unadjusted (*OR* = 1.55, 95% *CI* =1.22 -1.98 $p < 0.001$). The association between depression and obesity and other possible factors which may influence was more evident among U. S populations than Europeans $p < 0.05$ more so for depressive disorder than symptoms of depression ($p = 0.05$). Overweight, however, was associated with heightened risk of the onset of depression at follow up unadjusted ($OR = 1.27$; 95% CI = 1.07-1.55 $p < 0.01$) the findings were statistically significant especially among adults age 20-59 years and adults > 60 years (De Wit et al., 2010).

As previously stated, obesity is a known public health problem. According to Rush, LeardMann, & Crum-Ciaflone (2016) the prevalence of obesity has increased to nearly three times the prevalence rate among the national united stated population over the preceding decades. This figure equated to about 13%- 36% and the consequences are detrimental. These consequences include poor health outcomes, untimely death, healthcare costs, loss of productivity and other psychosocial expenses (Rush et al., 2016). For an individual to enlist in the United States military, standards for weight, height and body structure is required. As a result, obesity prevalence rates are lower for active duty personnel than in the general population. Nevertheless, Littman et al. (2013), reported that weight gain is noted to be relatively higher around 3years before discharge (1.0kg-1.3kg/yr.) compared to (0.6kg-0.7kg) while on active duty. Also, an increase of 0.7kg annually after service period is noted. This trend of weight gain sheds light regarding the increased rate of weight gain that occurs post deployment.

Summary of Literature review

Although many studies have outlined obesity prevalence, risk factors, and comorbidities, the impact of depression on health outcomes among veterans. There were limited cross-sectional studies that described the associated between BMI and depression on HBAIC regulation. Through the literature review, it was evident that diabetes, depression and obesity are prevalent health conditions globally with significant adverse health outcomes.

For instance, a study by Nelson (2006) utilized data from the 2003 Behavioral Risk Factor Surveillance System among a national veteran sample of 242,362 to compare rates of obesity among veterans including veterans who do and do not utilize the VA for care compared with nonveterans. In this study, the report concluded higher rates of obesity was present among veterans who used the VA for health services 27.7% compared to 22.8 for nonveterans. The average age was higher than 60 years with documented prevalence of DM type II, high blood pressure, high cholesterol, coronary artery disease, and arthritis. Also, these veterans were more apt to adverse health outcomes secondary to poor mental and physical health, and poor self-care activities as a result of the combined health problems.

Cruz-Cano et al. (2015), in a meta-analysis, studied the association between obesity and depression in patients with diabetes. However, their goal was to understand whether obesity increases the risk of depression among patients with the diagnosis of DM type II. Similarly, Lustman and Clouse (2005) conducted a review from multiple prospective and cross-sectional studies to understand depression in patients with diabetes and how it correlates with mood and diabetic control. In the synthesis and findings, the authors concluded concomitant depression is linked with poor glycemic control, medication noncompliance, poor dietary habits, poorer quality of life, and increase healthcare costs.

In this study I add to the body of literature by examining the association between BMI and depression to understand whether the association predicts poor glycemic control among veteran's using secondary data analysis from the VA. The results will inform providers at the VA with the knowledge that can enhance the development and implementation of joint forces between mental health and primary care providers. Also, it will improve preventative interventions and clinical indicators to strengthen AIC regulations.

This dissertation was quantitative with cross-sectional study design. The principal method of data collection was by review of electronic medical record and secondary data analysis from a previous study conducted by the VA research department. A sample of 89 veterans was randomly selected from a secondary database of an earlier study which consisted of adult veteran's with DM type II age 18 years to 99 years. Once the participants were selected the electronic medical record was reviewed for further variables. In section 2, the research design, methodology, data collection, results, findings and conclusions will be further discussed.

Section 2: Research Design and Data Collection

Introduction

In this section, I will outline the research methods used in this study to understand the association between BMI and depression through a secondary data analysis. Using a cross-sectional design, I aimed to determine the association between BMI and depression and to examine whether the association predicts HBA1C control among veterans. This chapter will include a discussion of the sample, data collection methods, and protection of participants.

I developed the following research questions and hypotheses to guide this study:

RQ1: Is there an association between BMI and depression among veterans?

$H_0$1: There is no association between BMI and depression

$H_1$1: There is an association between BMI and depression.

RQ2: Does the interaction between BMI and depression predict HBA1C regulation among veterans?

$H_0$2: The interaction between BMI and depression does not predict HBA1C regulation among veterans.

$H_1$2: The interaction between BMI and depression does predict HBA1C regulation among veterans.

Table, 2.

Research Questions, Variables, Variable Type, and Method of Analyses

Research Questions	Variables	Type of Variable	Analyses
Is there an association between BMI and depression Among Veteran's?	BMI Depression (PHQ-2 SCORE)	Continuous (Ratio) Categorical (Ordinal)	Linear Regression
Does the interaction Between BMI and depression predict HBAIC regulation?	BMI Depression (PHQ-2 SCORE) Glycemic level (HBA1C)	Continuous (Ratio) Categorical (Ordinal) Continuous (Ratio)	Multiple Regression

Power and Sample Size

Power and sample size were both relevant to examining the association between depression and BMI in this study. According to Goldstein (2002), when plotting statistical power, the investigator should test an experiment with either power of 80% or 90%. To determine the sample for this study, I performed an a priori calculation with G Power 3.1.9.2, a statistical software used to calculate statistical power and to determine effect size (Faul, Erdfelder, Lang, & Buchner, (2007). Using regression with a total of five predictors, an alpha level of 0.05, a power level of 0.90, and a medium effect size of 0.2, the power analysis estimated that I required a sample size of 89 to reach a power level of 0.90 in this study.

Table, 3

A Priori Power Analyses

F tests - Linear multiple regression: Fixed model, R^2 increase			
Analysis:	A priori: Compute required sample size		
Input:	Effect size f^2	=	0.20
	α err prob	=	0.05
	Power (1-β err prob)	=	0.90
	Number of tested predictors	=	5
	Total number of predictors	=	5
Output:	Noncentrality parameter λ	=	17.8000000
	Critical *F*	=	2.3244732
	Numerator *df*	=	5
	Denominator *df*	=	83
	Total sample size	=	89
	Actual power	=	0.9036951

Protection of Human Subjects and Participant Information

The protection of human subjects is of utmost importance to every study. In this study, I guaranteed participants anonymity, confidentiality, and security of data through the omission of personal identifiers per the Health Insurance Portability and Accountability Act of 1996 (HIPAA). HIPAA and informant consent waivers were completed to the standards of the VA institutional review board (IRB) requirements to ensure compliance. I replaced personal identifiers for patients with a unique random study identifier in the excel dataset for analysis. All data were stored in a secured folder created by the VA IRB and on a secured VA network, ensuring that the only person that had access was me, the principal investigator.

I used retrospective data in this study; therefore, no interventions were made. The only likely risk was the potential loss of confidentiality as a result of the research. If a breach of privacy had been detected, to protect participants I would have notified the privacy officer of the VA immediately. Guidelines were followed as directed, such as those concerning contact with patients, documenting breach of confidentiality in a secure and locked area, and informing the IRB of Walden University.

Research Design and Strategy

The critical method of data collection in this study was through secondary data analysis. Public health has historically gathered data that has contributed significantly to surveillance activity and longitudinal survey research; nonetheless, it is costly to collect this type of data through primary research (California Department of Public health, 2016). The availability of electronic health record information made it possible to gather compressed data in the least expensive way using secondary data analysis.

The data I used to accomplish my research goals in this study were made available from a previous Health Research Studies and Implementation Projects funded research. That research was conducted at the VA using a randomized controlled trial of an intervention modeled to increase veterans' active participatory communication patterns, after-visit ranking of self-efficacy to communicate, medication compliance, and diabetic control (HBA1C). The study title was "Randomized Trial of an Educational Intervention in DM type II Patients. Protocol Number 12–32." The Health Research Studies and Implementation Project collected data on a diverse group of the veteran population living in Illinois, and the data contained patient demographics and/or characteristics, such as age, gender, race/ethnicity, HBAIC, lab values, vital signs, and medical diagnosis.

Protection of Participant rights

All information was de-identified per the IRB and HIPAA privacy guidelines of the VA. Pertinent patient data remain secured at the research department of the VA. The total data collection process and analysis took about 3 months. I created an Excel spreadsheet was created for the data collection. The variables of interest were age, sex, BMI, weight, Patient Health Questionare-2(PHQ-2) score, and HBA1C level. In this study, I used existing information in the medical chart to evaluate the association between BMI and depression.

One of the risks that I thought would be likely to this process was the potential loss of confidentiality as a result of the research. However, the risk was decreased by my use of a limited secondary data set of about 147 participants. All data from this study were secured in a password-protected VHA server to ensure that only I had access to the data. Personal identifiers for participants were replaced with a unique, random study identifier in all analytic data sets. I created a key to link social security numbers of the sample to the unique random study identifiers I used for the study in the event that study data must be compared to source data to resolve inconsistencies. The key was password-protected and stored on the secure VHA server, ensuring that I, the only principal investigator personnel have access to the data.

Setting and Sample

The study sample was comprised of a diverse group of a veteran population living in Illinois who used the VA facility in an urban area. I requested a waiver of consent to conduct a chart review and obtained the data necessary for the study through the IRB. The waiver of consent was obtained because the selection of subjects was from a database of previous research. As a result, it was impossible for me to locate each subject and have that individual go to a facility to sign a consent form. The financial burden and time dedicated to seeking a consent form from every veteran whose record would be examined would have limited the study sample size, which in turn would have limited generalizability of the review; hence, my use of the request of the waiver. There was a total of 88 participants with 79 (86.4%) identifying as male and 12 (13.6%) identifying as female. The average weight of the participants was 233.8 (*SD* = 49.456) with a minimum weight of 161.0 and a maximum weight of 492.0 for a weight range of 330.4 pounds. The average HBA1C was 9.601 with a minimum score of 6.8 and a maximum score of 13.3 for a range of 6.5. The average BMI was 35.2 with a minimum score of 29.04 and a maximum score of 79.40 for a range of 50.35. There were 29 participants (32.2%) who had a major depressive disorder and 61 (67.8%) who did not. There were 44 (50.0%) Vietnam Era veterans followed by 28 (31.2%) Post-Vietnam, 12 (13.6%) Persian Gulf War, and four (4.6%) Post-Korean participants. See table 4 for demographic characteristics of the sample.

Table 4.

Demographic Characteristics of the Sample

Demographic	Level	Frequency (%)
Age		
	35-44	1 (1.1%)
	45-54	11 (12.4%)
	55-64	36 (40.4%)
	65-74	41 (46.1%)
Gender		
	Male	78 (87.6%)
	Female	11 (12.4%)
Race		
	White	9 (10.1%)
	Black	75 (84.3%)
	Other	5 (5.6%)
BMI		
	Below 35	60 (67.4%)
	Above 35	29 (32.6%)
Era of Service		
	Post-Korean War	2 (2.2%)
	Vietnam	45 (50.6%)
	Post-Vietnam	30 (33.7%)
	Persian Gulf War	12 (13.5%)
Marital Status		
	Married	39 (43.8%)
	Divorced	23 (25.8%)
	Separated	4 (4.5%)
	Widowed	3 (3.4%)
	Never Married	20 (22.5%)
Primary Care		
	Yes	75 (84.3%)
	No	14 (15.7%)

The study inclusion criteria for the study were veteran, 18yrs – 99 yrs. old, diagnosis of diabetes, HBAIC > 7.5mg/dl. PHQ-2 score, and BMI. Exclusion criteria: Diabetes type 1, diagnosis of schizophrenia

Data Analysis

Statistical Package for the Social Sciences (SPSS) Version 22 (Armonk, NY: IBM Corporation (2017) was used for data analysis. Statistical significance was assumed at an alpha value of (*p*, 0.05). The data in Excel spreadsheet had unique patient identifiers collected at the VA site. The unique patient identifications were generated to protect participants.

Statistical Methods

The assumption of normality for continuous variables was assessed with skewness and kurtosis statistics. If either statistic was above an absolute value of 2.0, then the distribution was assumed to be non-normal. Mann-Whitney U was used for between-subjects comparisons when the assumption was violated. Medians and interquartile ranges (IQR) were reported for these tests. Multiple regression was used to test the multivariate associations between age, BMI, gender, primary care affiliation, period of service, marital status, and ethnicity. Linearity, normality, and homoscedasticity were assessed using normal probability plots and residual analysis. Durbin-Watson statistics were used to test for autocorrelations and variance inflation factor (VIF) was used to check for multicollinearity. Change in shared variance and beta values were reported for the regression model. All analyses were conducted in SPSS Version 22 (Armonk, NY: IBM Corporation (2017) and statistical significance was assumed at an alpha value of 0.05. In section 3 of this study, I will further discuss the statistical results and recommendations.

Section 3: Presentation of the Results and Findings

Introduction

In this study, I aimed to examine the association between BMI and depression and to test whether this association had an impact on a veteran's ability to control diabetes as evidenced by the HBAIC lab value. This evaluation was conducted by reviewing documented BMI, depressive symptoms, and the HBA1C level as recorded in the veterans' computerized medical records. This third section chapter will discuss results and findings of the study.

Results of Research Question 1

With Research Question 1, I asked: Is there an association between BMI and depression see table 5 for descriptives.

Table, 5.

Descriptive Statistics

	N	*M*	*SD*	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	*STD.* Error	Statistic Error	*STD*
BMI	88	35.315	7.3850	3.165	.257	14.388	.508
Valid *N* (listwise)	88						

BMI was not normally distributed per skewness and kurtosis statistics. I used a nonparametric Mann-Whitney *U* test to compare the no depression vs. depression groups. (Mann-Whitney (*U*) = 774.000, Wilcoxon (*W*) = 2544.00 *Z* = -.723, 2-tailed p value 0.469). There was a no significant difference in BMI between the no depression and depression groups with (*p* = 0.47. BMI; depressed *M*= 32.761 *IQR* = 7.8) BMI; Non depressed groups (*M* = 33.274, *IQR* = 5.0).

Results of Research Question 2

Research Question 2 was: Does the interaction between BMI and depression predict HBAIC regulation among veterans? In the first model, I used multiple regression to analyze whether BMI and no depression versus depression predicted for HBA1C regulation. See table 6 below for the model summary?

Table, 6.

Beta coefficients to analyze the interaction between depression vs.. No depression groups

Model		Unstandardized *B*	Coefficients Std. Error	Standardized Coefficients Beta	*t*	Sig.	Collinearity Tolerance	Statistics VIF
1	**(Constant)**	10.483	1.556		6.736	.000		
	Depressed	-.210	1.756	-.072	-.120	.905	.032	31.144
	BMI	-.031	.044	-.168	-.710	.480	.209	4.787
BMIDepressioninteraction		.017	.049	.233	-348	.729	.028	35.213

In the table, the beta coefficients show that depression was not predictive of HBA1C, (*p* = 0.905, nor was BMI, p = 0.48). The association between the two (an interaction term) was also not significant, (*p* = 0.73). Second in the regression model, I entered BMI, an interaction term for depression*BMI, age, gender, race, era of service, marital status, and primary care status

Table, 7.
Regression Coefficients

Independent Variables	B (SE)	*Β*	*p*-value
Constant	12.27 (2.10)	-	< 0.001
Age	-0.04 (0.03)	-0.22	0.19
BMI	-0.02 (0.02)	-0.10	0.41
Depression	-0.12 (0.61)	-0.03	0.77
Gender	-0.10 (0.51)	-0.02	0.85
Primary Care	0.39 (0.46)	0.10	0.40
White	1.19 (0.87)	0.25	0.18
Black	0.89 (0.70)	0.22	0.21
Married	0.07 (0.43)	0.02	0.88
Divorced	0.03 (0.48)	0.01	0.96
Separated	-0.94 (0.82)	-0.13	0.26
Widowed	-1.24 (0.93)	-0.15	0.19
Post-Korean War	-0.55 (1.33)	-0.06	0.68
Vietnam War	-0.14 (0.62)	-0.05	0.82
Post-Vietnam War	-0.28 (0.52)	-0.09	0.60
Depression*BMI	-0.02 (0.01)	-0.22	0.07

Note: B (SE) – Unstandardized beta coefficient (Standard error), β – Standardized beta coefficient

The variables did not account for a significant increase in shared variance in HBA1C (ΔR^2 = 0.17, F (14,74) = 0.17, p = 0.37).

Figure 1.

Histogram displays test for the assumption of normality

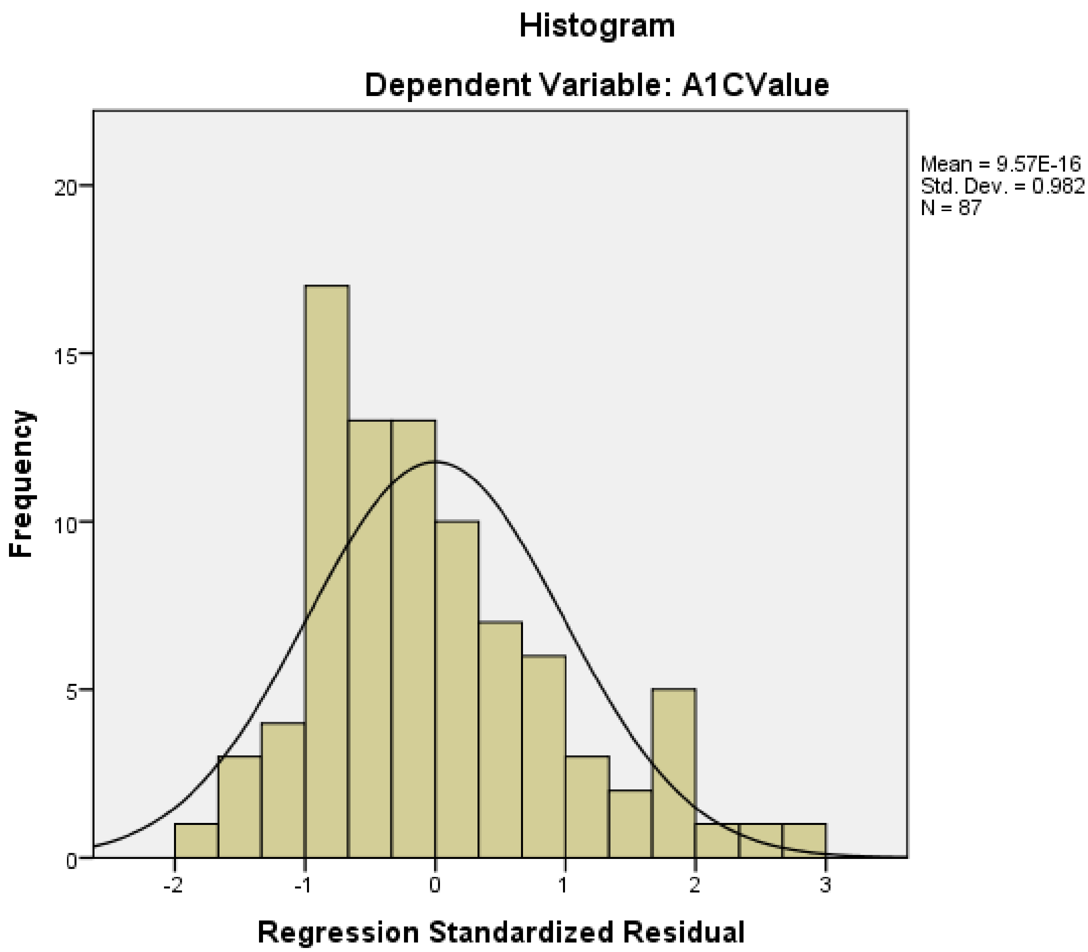


Figure 2.

Test for linearity

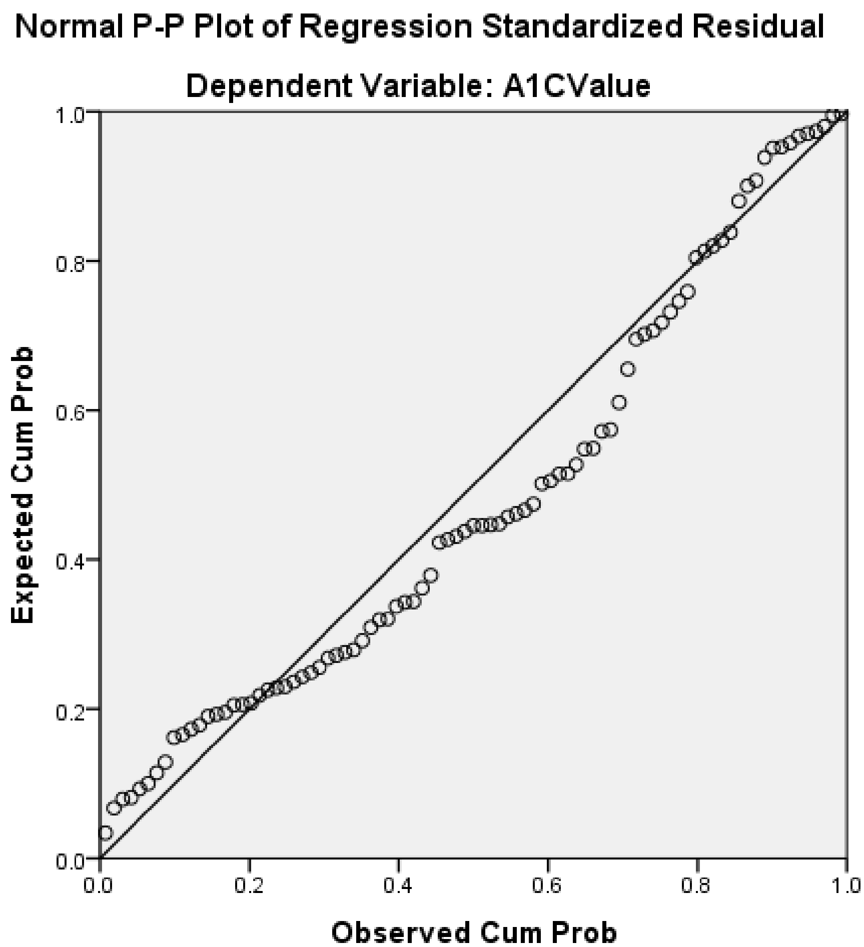
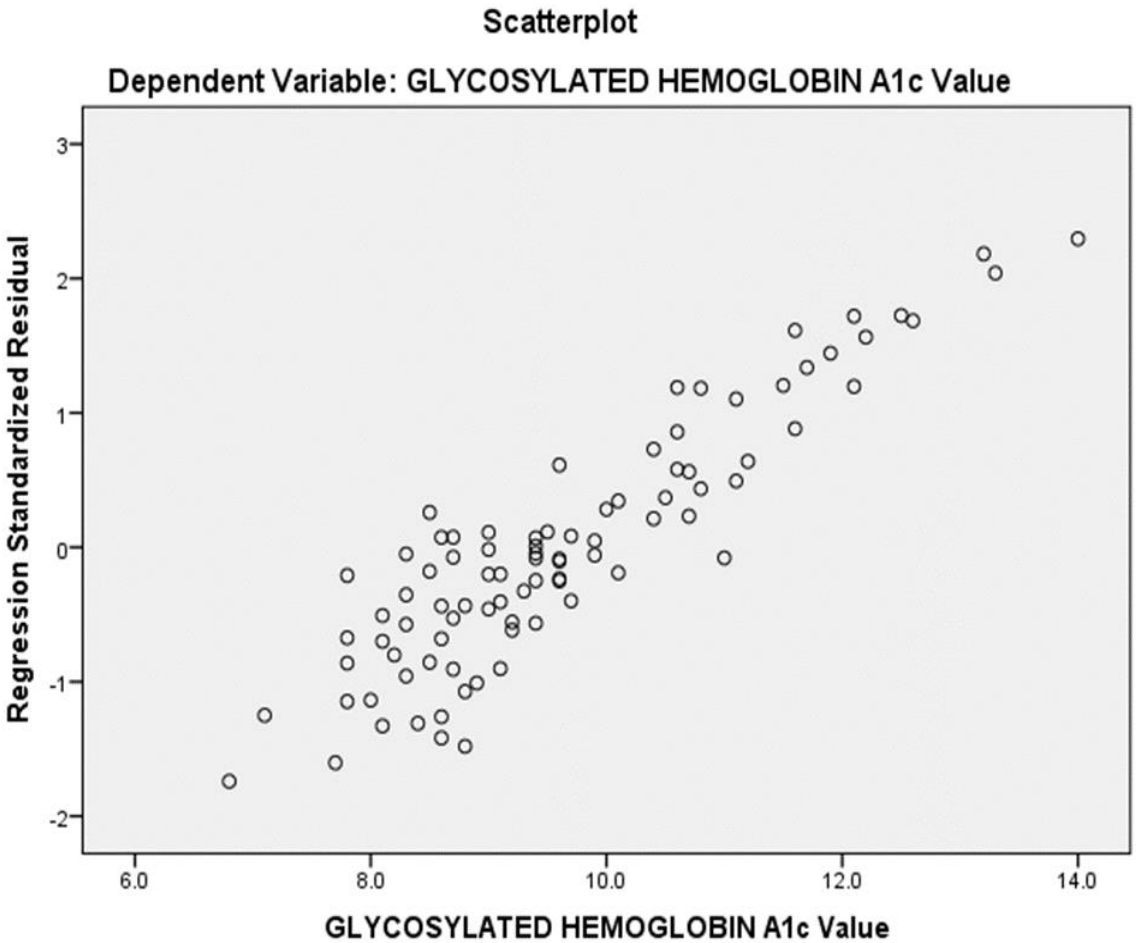


Figure 3.

Scatter plot, test for homoscedasticity.



Summary

I tested the two hypotheses for the association between depression and BMI on HBA1C control. The association between BMI and depression were addressed in Research Question 1, and the results revealed no association between BMI and depression, (R = 0.02, p = 0.46). The results for Research Question 2 revealed the association between BMI and depression was not predictive of HBA1C among veterans ($\Delta R2$ = 0.03, F (2, 84) = 0.80, p = 0.50). I collected the six socio-demographic variables of marital status, primary care affiliation, service era, race, age, and gender to analyze their influence on HBA1C control; however, according to the regression analysis, they were not predictors of HBA1C regulation. There was not a significant increase in significant increase in shared variance in A1C, ΔR^2 = 0.17, F (14, 74) = 0.17, p = 0.37. There was no significant interaction observed between the variables of marital status, race, era of service, age, gender, and primary care affiliation on HBA1C regulation.

Due to violations of normality, I assessed the association between depression and BMI in a nonparametric fashion. For Research Question 1, there was a not a statistically significant difference between those who were depressed (*Mdn* = 32.76, *IQR* = 7.8) and those who were not depressed (*Mdn* = 33.27, *IQR* = 5.0) in terms of BMI, (U = 774.0, p = 0.47). Assumptions for the regression model were met per residual analysis, normal probability plots, Durbin-Watson statistics, and variance inflation factor (VIF). When the predictor variables were entered into the regression model to answer research question 2, they did not account for a significant increase in shared variance in HBA1C (ΔR^2 =

0.17, $F(14,74) = 0.17$, $p = 0.37$). In section 4 of this study, I discussed these the overall impact of chronic disease on population health, I drew in findings from other publications relevant to my dissertation. In addition, I also discuss the overall impact of obesity, diabetes and depression on veteran's health and I make recommendation for social change and urge primary care and mental health providers to provide seamless health care for the nation's veterans.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

Chronic diseases exert an enormous cost on the U.S. economy. Seeman, Merkin, Crimins & Karamangla (2010), publicized findings from a NHANES cross-sectional survey on diabetes prevalence between the years 1988–1994 and 1999–2012. Based on their findings from NHANES the authors reported that the increased rates of DM type II results from a combination of an aging U.S population, obesity, physical inactivity, and genetic factors. They also concluded high unadjusted prevalence rates of diabetes among persons 65 years and older.

In the United States, an estimated 133 million people are plagued with more than one chronic condition including diabetes, high blood pressure, and/or respiratory disorders. The projected amount of the population with chronic conditions are expected to grow to 157 million by the year 2020 (Raghupathi W & Raghupathi V, 2018). However, U. S. veterans often suffer many other chronic diseases that include at least one mental health disorder (Agarwal, 2005). In Illinois, the veteran population over the age

65 totals 348,000 out of a total veteran population of 722,000 (U.S. Department of VA, 2015). The VA is known to possess one of the largest integrated healthcare organizations in the United States where over 3 million veterans seek health care annually (U.S. Department of VA, 2015). Veterans are recognized to be a unique population, based on their military and or combat experiences; therefore, the VA offers comprehensive health care benefits to meet the needs of the veterans (Yu et al., 2003).

As of the year 2017, the VA (2018) reported the veteran population to be 19.9 million, of which 9.05 million were enrolled in the VA health system in 2016. In that same year 2016, there were also 6.26 million unique patients that received treatment (2018). The VHA has reported the substantial burden of chronic illness among veterans and supports efforts that target the prevention and reduction of chronic diseases (US Department of VA, 2018). Based on the strategic goals set forth by the VA secretary, there is the need to improve the timeliness of the care delivered to veterans and veterans deserve lifelong integrated care that supports and stresses their wellbeing and independence (U.S. Department of VA, 2018).

This strategic goal aligns with the vision of Healthy People 2020 with a focus to provide high-quality care and ensure long lives without disability and diseases from preventable causes (U.S. Department of Health and Human Services, 2010). The results of this study will augment what has been previously conducted and published in the area of diabetes, depression, and chronic health management. In the SCT, Bandura (1986) stated that social environments and past experiences influence whether a person will engage in a specific behavior; however, for this study, I assumed that individuals who are depressed would unlikely participate in prescribed activities to improve their health.

Interpretation

Many research studies have perfected our understanding of BMI and depression; however, no one had reported the impact of the association of those variables on HBA1C regulation. Although Konttinen et al. (2014) focused the association between depressive symptoms and BMI in a 20-year longitudinal study, the researchers reported that men tend to have a rapid growth in BMI when they have higher depressive symptoms versus women. These findings were consistent with a meta-analysis by Wardle, Gibson, Whitaker, and Steptoe (2011), who reported significant life events and episodes of acute stress have a substantial impact on obesity prodrome, more so among men than among women. In a population-based study among the Finnish, Konttinen, Sarlio-Lahteenkorva, Mannisto, and Haukkala (2010) reported a positive correlation between depressive symptoms and fat indicators were secondary to emotional eating and individual instinct on physical activity.

In this study, I selected a sample of 88 diabetic veterans from a VA hospital by use of secondary data. Among the sample, 33% were depressed, and 67% were not depressed. First, I aimed to understand the association between BMI and depression; however, my data analysis revealed no association between BMI and depression (Mdn = 32.76, IQR = 7.8) and those who were not depressed (Mdn = 33.27, IQR = 5.0) in terms of BMI, (U = 774.0, p = 0.47). This variance potentially arose from the fact that 42% of the sample selected was 65 years old and higher, and the VA report only 11% of veterans age 65 years and older meet the diagnosis of depression.

Second, I aimed to establish whether the association between BMI and depression were predictive of HBA1C regulation among veterans. When the six predictor variables were entered into the regression model to answer Research Question 2, For Research Question 2, when depression, BMI, an interaction term for depression*BMI, age, gender, race, era of service, marital status, and primary care status were entered into the regression model, they did not account for a significant increase in shared variance in A1C,($\Delta R^2 = 0.17$, $F(14,74) = 0.17$, $p = 0.37$).The VA and numerous other researchers have publicized depression as a common condition among veterans. In a longitudinal study of the effects of depression on A1C control among 11,555 veterans with DM II, Richardson, Egede, Mueller, Echols, and Gebregziabher (2008) reported that over time HBA1C levels were significantly higher among depressed veterans versus non depressed veterans. The mean age of the veterans in their study was 66 years with a follow-up period of 4.1 years. They concluded that depression drives higher HBA1C levels over time, confirming a longitudinal relationship (Richardson et al., 2008).

In fact, the VA healthcare system has reported about 25% of the veteran population who are seen within the healthcare system have diabetes (VA, 2016). A significant amount of veterans are also known to suffer from chronic pain, substance abuse, and mental illness which limits their ability to engage in physically active lifestyle (Holz et al., 2014). Understanding what drives HBA1C regulation beyond obesity and depression may be complex because the health risks and concerns of veterans vary based on the country of deployment (VA, 2016). For instance, during the Vietnam War, there were concerns of Agent Orange exposure, a tactical herbicide sprayed by the U.S. military on trees and other vegetation (VA, 2016).

Sang-Wook, Jae-Seok, Heechoul, and Jee-Jeon (2014) reported that among Vietnam war veterans, Agent Orange exposure is linked to the prevalence of thyroid and pituitary gland disorders. The younger cohort of Iraqi and Afghanistan veterans were also exposed to various environmental and chemical hazards that bore specific health risks (US Department of VA, 2018). Binge eating has also been associated with Iraq/Afghanistan veterans who exhibit post-traumatic stress disorder and depressive symptoms, leading to disproportionate rates of obesity observed among this group of veterans. In this study, I used a small sample of veterans and a cross-sectional design and did not explore the cause and effect of other characteristics that may drive poor glycemic control besides depression and obesity.

Recommendations

As I previously discussed, effective glycemic control, as evident by a low HBA1C score, produces less diabetic-related complications and improves quality of life, while poor glycemic control will result in a higher HBA1C score which creates a reduced quality of life and diabetic-related complications such as cardiovascular, microvascular and macrovascular diseases ((Zaccardi et al.). Among persons with diabetes, 30% are known to be concurrently depressed. When a person suffers from depression and diabetes simultaneously, complications are heightened, healthcare cost increased, frequent healthcare utilization, leading to poor outcomes (Richardson et al., 2008).

The results of this study as well as those of other literature on diabetes, depression, and obesity indicate that the combination of these three issues is a public health problem that warrants attention and should drive our focus to primary intervention modalities. My review of extant research confirmed that prediabetes is a risk factor for diabetes development, which happens insidiously over approximately 4 years in 23% of the prediabetes population (Hillmer et al 2017). Interventions that address lifestyle changes such moderate physical activity, balanced diet, and healthy weight loss can delay prediabetes turning into diabetes (Hillmer et al., 2017). In conjunction, obesity is a complex issue with no single solution that requires a collaborative approach from the community, state, business community, healthcare professionals, and schools to chime in and devote resources to curtail the epidemic. The golden standard for solving the obesity epidemic is healthy eating habits and frequent physical activities (CDC, 2017). Depression is a common mental health disorder that can co-occur with medical illnesses, such as diabetes, and it is characterized by low mood and irritability (National Institute of Mental Health (NIMH), 2018) however, no matter how severe the depression may be, it can be treated with medication and or psychotherapy (NIMH, 2018). The key to managing symptoms is medication and treatment compliance in addition to physical activity (NIMH, 2018). Physical activity will help counteract weight again; the side effects of antidepressants and improve the overall mood of the individual (NIH, 2018).

Several factors affect an individual's social and health wellbeing, such as socioeconomic environment, dietary pattern, physical environment, family, cultural and social beliefs, trade, economics, and policies (Kumar & Preetha, 2012). As humans continue to develop an understanding of the factors that affect health and social well-being, health issues have to be addressed holistically. Creating the means to empower individuals and empower communities to take control of their health and foster public health leadership can work collaboratively to build effective public health policies in all avenues and create long-lasting healthcare systems (Kumar & Preetha, 2012).

Implications for Future Research

In this study, I focused on the veteran population in an urban area of Illinois. The results from this study may be generalized to a national community of veterans who have similar backgrounds of military and combat experience. I also looked at depressive symptoms reported over a three-month period versus actual diagnosis of depression per International Classification of Diseases Tenth Revision, Clinical Modification (ICD-10-CM). Although war era was not the focus of this study, prior research has found that many illnesses stem from environmental exposure suffered during combat (Mclean And Edwards, 2016). Veterans have unique experiences compared to the average nonveteran and stand at risk for poorer health with mental illnesses being a top priority area of concern (Maclean & Edwards, 2016). Although the researchers did not find an association between BMI and depression, Richardson et al. (2008) confirmed a longitudinal relationship between the variables, therefore showing that over time, depression can contribute to higher HBA1C levels among veterans.

HBA1C is known to be the key indicator of glycemic control over a period of 2–3 months and also informs the clinician of the risk of diabetic-related complications. Higher A1C levels put an individual at risk for stroke and cardiovascular disease (Sherwani, Khan, Ekhzaimy, Massod, & Sakharkar, 2016). Based on this knowledge, clinicians can continue to educate veterans regarding the clinical risks of poor glycemic control. Depressive symptoms have been reported higher among persons with diabetes and can produce poor blood sugar levels (Sherwani et al, 2016). Therefore, it is important for clinicians to join efforts with mental health providers while caring for veterans. Further research is warranted for a national study of the veteran population and consideration should be made for veterans who are being treated for depression compared to those who do not receive treatment. Other factors worth exploring are the impact of socioeconomic status and homelessness on the management of chronic diseases.

Social Change Implications

Despite the numerous publications regarding obesity, diabetes, and depression which affect the population, there are still many strides needed to achieve a society free of chronic illness. This study shed light on the many complications that affect an individual when they are faced with multiple comorbidities and can aid the veterans' health administration to beef up resources and programs that target veterans who met with this health challenge. There is the opportunity to focus on how clinicians can work collectively together within primary care setting to ensure resources and referrals are seamless upon initial contact with the veteran. The study results can add to the current body of literature about diabetes, obesity, depression and veteran's health.

Also, it contributes to relevant information to the research which supports that depression can produce ineffective glycemic control. That the rates of obesity are on the rise because of physical inactivity and poor HBA1C leads to poor health outcomes. Results of this study will be disclosed to decision makers of the VA medical center where the study was conducted. This will provide the opportunity for programs to be reviewed and resources allotted to areas that can be beneficial. As previously stated, chronic diseases exert an enormous cost to the economy. To prevent these diseases can be achieved by modifying risk factors. Otherwise, if left untreated, it can lead to severe complications leading to disability and death. Looking at the characteristics of veterans and the many chronic conditions, clinicians need to focus on disease-specific interventions on enhancing well-being.

Conclusions

Multiple chronic conditions demand to routine and multifaceted care management. When an individual harbors numerous chronic conditions it promotes reduced quality of life and function and mortality, and morbidity are both increased. The high prevalence of chronic conditions can increase health care costs, morbidity, and mortality. The veterans' health care administration reports a high burden of multiple chronic diseases compared to the general population among veterans. To improve the quality of chronic care does require an expansive understanding of the mental health issues facing the veterans order to provide improvement modalities.

The study has outlined significant multiple health indicators and avenues for prevention. However, it is imperative to understand the importance of including the veteran as a partner to wellness when structuring interventions. Most importantly providers need to pay close attention to depressive symptoms as this will trigger early detection to initiate timely treatment.

References

Afari, N., Noonan, C., Goldberg, J., Roy-Byrne, P., Schur, E., Golnari, G., & Buchwald, D. (2010). Depression and obesity: Do shared genes explain the relationship? *Depression and Anxiety, 27*(9), 799-806. doi:10.1002/da.20704

Agarwal, M. (2005). Translating research into quality health care for veterans. Retrieved from https://www.hsrd.research.va.gov/publications/internal/forum11_05.pdf

American Diabetes Association. (2010, Jan). Diagnosis and classification of diabetes mellitus. *Diabetes Care*, *33*, S62-S69. doi:10.2337/dc10-S062

American Diabetes Association. (2018). Statistics about diabetes. Retrieved from http://www.diabetes.org/diabetes-basics/statistics/

Andreoulakis, E., Hyphantis, T., Kandylis, D., & Iacovides, A. (2012). Depression in diabetes mellitus: a comprehensive review. *Hippokratia*, *16*(3), 205–214.

Badescu, S., Tataru, C., Kobylinska, L., Georgescu, E., Zahiu, D., Zagrean, A., &Zagrean, L. (2016). The association between diabetes mellitus and depression. *Journal of Medicine and Life*, *9*(2), 120-125. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4863499/

Bajaj, S., Agarwal, S. K., Varma, A., & Singh, V. K. (2012). Association of depression and its relation with complications in newly diagnosed DM type II. *Indian Journal of Endocrinology and Metabolism*, *16*(5), 759-763. doi:10.4103/2230-8210.100670

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*

Englewood Cliffs, NJ: Prentice Hall

Bandura, A. (1988) *Self-regulation of motivation and action through goal systems*. In V. Hamilton, G.H Bower, & N.H Frijda (Eds), NATO ASI series D: Behavioral and social sciences (44). Cognitive perspectives on emotion and motivation (pp.37-61) New York, NY: Kluwer academic/ Plenum Publishers

Bandura, A. (1988). Organizational applications of social cognitive theory. *Australian Journal of Management*, *13*(2). Retrieved from https://www.uky.edu/~eushe2/Bandura/Bandura1988AJM.pdf

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, *44*(9), 1175-1184. doi:10.1037/0003-066X.44.9.1175

Bays, H., Chapman, R., & Grady, S. (2007). The relationship of body mass index to diabetes mellitus, hypertension and dyslipidemia:Comparison of data from two national surveys. *International Journal of Clinical Practice*, *6*(5), 737-747. doi:10.1111/j.1742-1241.2007.01336.x

Benton, D. (2015). Portion size: What we know and what we need to know. *Critical Reviews in Food Science and Nutrition*, *55*(7), 988-1004. doi:10.1080/10408398.2012.679980

Berge, L. I., & Riise, T. (2015). Comorbidity between DM type II and depression in the adult population: Directions of the association and its possible pathophysiological mechanisms. *International Journal of Endocrinology*, *2015*. doi:10.1155/2015/164760

Berge, L. I., Rilse, T., Tell, G. S., Iverson, M. M., Ostbye, T., Lund, A., & Knudsen, A. K. (2015). Depression in persons with diabetes by age and antidiabetic treatment: A cross sectional analysis with data from the Hordaland health study. *Plos One*, *10*(5), 1-15. doi: 10.137/journal.pone.0127161

Bergmann, K., & Sypniewskwa, G. (2012). Diabetes as a complication of adipose tissue dysfunction: Is there a role for potential new biomarkers? *Clinical Chemistry and Laboratory Medicine*, *51*(1), 177-185. doi:10.1515/cclm-2012-0490.

Centers for Disease Control and Prevention. (2012). Diabetes report card. Retrieved from https://www.cdc.gov/diabetes/pubs/pdf/diabetesreportcard.pdf

Centers for Disease Control and Prevention. (2016). Defining adult overweight and obesity. Retrieved from https://www.cdc.gov/obesity/adult/defining.html

Centers for Disease Control and Prevention. (2017b). Nutrition, physical activity, and obesity prevention strategies. Retrieved from https://www.cdc.gov/obesity/resources/strategies-guidelines.html

Centers for Disease Control and Prevention (2017a). The health effects of overweight and obesity. Retrieved from https://www.cdc.gov/healthyweight/effects/index.html

Curtis, A. B., Kothari, C., Paul, R., & Connors, E. (2013). Using GIS and secondary data to target diabetes-related public health efforts. *Public Health Reports*, *128*(3), 212-220. doi:10.1177/003335491312800311

De La Cruz-Cano, E., Tovilla-Zarate, C., Reyes-Ramos, E., Gonzales-Castron, T. B., Jaurez-Castro, I., Lopez-Narvaez, M. L., & Fresan, A. (2015). Association between obesity and depression in patients with diabetes mellitus Type 2: A study protocol. *F1000Research*, *4*(7). doi:10.12688/f1000research.5995.1

De Wit, L., Luppino, F., Van Straten, A., Pennix, B., Zitman, F., & Cuiipers, P. (2010). Depression and obesity: A meta-analysis of community-based studies. *Psychiatry Research*, *178*, 230-235. doi:10.1016/j.psychres.2009.04.015

Del Re, A. C., Maciejewski, M. L., & Harris, A. H. (2013). MOVE: Weight management program across the Veterans' Health Administration: Patient- and facility-level predictors of utilization. *BioMed Central*, *13*(511). doi:10.1186/1472-6963-13-511

Deshpande, A. D., Haris-Haynes, M., & Shootman, M. (2008). Epidemiology of diabetes and diabetes-related complications. *Journal of the American Physical Therapy Association*, *11*, 1254-1264. doi:10.2522/ptj.20080020

Djalalinia, S., Qorbani, M., Peykari, N., & Kelishadi, R. (2015). Health impacts of obesity. *Pakistan Journal of Medical Sciences*, *31*(1), 239-242. doi:10.12669/pjms.311.7033

Ecke, R. H., Kahn, S. E., & Smith, S. R. (2011). Obesity and type diabetes: What can be unified and what needs to be individualized. *Journal of Endocrinology Metabolism*, *96*(6), 1654-1663. Retrieved from http://www.biomedcentral.com/1472-6963/14/191exercise interventions.

Faul, F., Erdfelder, E., Lang, A., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences.

Behavior Research Methods, *39*(2), 175-191. doi:10.3758/bf03193146

Fiore, V., Marci, M., Poggi, A., Giagulli, V., Lacoviello, M., Gustamacchia, E., & Triggiani, V. (2015). The association between diabetes and depression: A very disabling condition. *Endocrine*, *48*(1), 14-24. doi:10.1007/s12020-014-0323-x

Flegal, K. M., & Graubard, B. I. (2009). Estimates of excess deaths associated with body mass index and other anthropometric variables. *The American Journal of Clinical Nutrition*, *89*, 1213-1219. doi:10.3945/ajcn.2008.26698

Forman-Hoffman, V. L., Yankey, J. W., Hillis, S. L., Wallace, R. B., & Wolinsky, F. D. (2007). Weight and depressive symptoms in older adults: Direction of influence? *The Journals of Gerontology*, *62*(1), S43-S51. doi:10.1093/geronb/62.1.S43

Franklin, H., Rajan, M., Tseng, C., Pogach, L., & Sinha, A. (2014). Cost of lower-limb amputation in U.S. veterans with diabetes using health services data in fiscal years 2004 and 2010. *Journal of Rehabilitation Research and Development*, *51* (8), 1325-30. doi:10.1682/JRRD.2013.11.0249

Gierach, M., Gierrach, J., Ewertowska, M., Arndt, A., & Junik, R. (2014). Correlation between body mass index and waist circumference in patients with metabolic syndrome. *ISRN Endocrinology*, *2014*. doi:10.1155/2014/514589

Green. (2000). The role of theory in evidence-based health promotion practice. *Health Education Research* (5), 125-129.

Green, L. W., Branchi, F. L., & Albright, A. (2012,). Primary prevention of DM type II: Integrative public health and primary care opportunities, challenges and strategies. *Oxford University Press*, *29*, i13-i23. doi:10.1093/frampra/cmr126

Gonzalez J.S, Safren., S.A, Cagliero., E, Wexler D. J., Delahanty, L., Wittenberg, Blais M, A., Meigs,J. B., Grant R.W. (2007). Depression, Self-Care, and Medication Adherence in Type 2 Diabetes. *Diabetes Care 30* (9) 2222-2227: doi**:**10.2337/dc07-0158

Herrera, B. M., & Lindgren, C. M. (2010). The Genetics of Obesity. *Current Diabetes Reports*, *10*(6), 498–505. doi:10.1007/s11892-010-0153-z

Hu, F. B. (2003). Sedentary lifestyle and risk of obesity and DM type II. *Lipids*, *38*(2), 103-108. doi:10.1007/s11745-003-1038-4

Hurt, R. T., Kulisek, C., Buchanan, L. A., & McClave, S. A. (2010). The obesity epidemic: Challenges, health initiatives, and implications for gastroenterologists. *Gastroenterology & Hepatology*, *6*(12), 780–792. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3033553/

Kinsinger, L. S. (2015, November-December). Disease prevention in the Veterans Health Administration. *North Carolina Medical Journal*, *78*(5), 335-338. doi:10.18043/ncm.76.5.335

Klien, S., Allison, D. B., Heymsfield, S. B., Kelley, D. E., Leibel, R. L., Nonas, C., & Kahn, R. (2007). Waist circumference and cardio metabolic risk: A consensus statement from shaping America’s health Association for weight management and obesity prevention. *The American Journal of Clinical Nutrition*, *85*(5), 1197-1202. doi:10.1093/ajcn/85.5.1197

Koepsell, T., Littman, A., & Forsberg, C. (2012, Feb). Obesity, overweight, and their life course trajectories in veterans and non-veterans. *Obesity: A Research Journal*, *2*. doi:10.1038/oby.2011.2

Konttinen, H., Kiviruusu, O., Huurre, T., Haukkala, A., Aro, H., & Marttunen, M. (2014). Longitudinal associations between depressive symptoms and body mass index in a 20-year follow-up. *International Journal of Obesity*, *38*, 668-674. doi: 10.1038/ijo.2013.151

Kumar, S., & Preetha, G. (2012). Health promotion: An effective tool for global health. *Indian Journal of Community Medicine*, *37*, 5-12. doi:10.4103%2F0970-0218.94009

Littman, A., Jacobson, I., Boyko, E., Powell, T., Smith, T., & Millenium Cohort Study Team (2013). Weight change following US military service. *International Journal of Obesity*, *37*(2), 244-253. doi:10.1038/ijo.2012.46

Lustman, P., & Clouse, R. (2005). Depression in diabetic patients: The relationship between mood and glycemic control. *Journal of Diabetes and its Complications*, *19*, 113-122. doi:10.1016/j.jdiacomp.2004.01.002

Maclean, A., & Edwards, R. D. (2016, 2016). Military service, combat exposure, and health in the later lives of U.S men. *Longitudinal and Life Course Studies*, *8*, 122-137. doi:10.14301/llcs.v8i2.427

Maguen, S., Madden, E., Cohen, B., Bertenthal, D., Neylan, T., Talbot, L., Seal, K. (2013). The relationship between body mass index and mental health among Iraq and Afghanistan veterans. *Journal of General Internal Medicine*, *28*(2), 563-570. doi:10.1007/s11606-013-2374-8

Marx, C. M. (2013). Economic implications of DM Type II management. *The American Journal of Managed Care*, *19*, S143-S148. Retrieved from http://www.ajmc.com/journals/supplement/2013/ace009_13jun_diabetes/ace009_13jun_mcadammarx_143-148

Miller, D. R., & Pogach, L. (2008). Longitudinal approaches to evaluate health care quality and outcomes. The Veterans Health Administration diabetes epidemiology cohorts. *Journal of Diabetes Science and Technology*, *2*(1), 24-32. doi:10.1177/193229680800200105

Mokdad, A. H., Ford, E. S., & Bowman, B. A. (2003). Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *The Journal of the American Medical Association*, *289*(1), 76-79. doi:10.1001/jama.289.1.76

National Center for Veterans Analysis and Statistics. (2015). Profile of veterans: 2015 data from the American Community Survey. Retrieved from https://www.va.gov/vetdata/docs/SpecialReports/Profile_of_Veterans_2015.pdf

National Institute of Health. (1998). Clinical Guidelines on the identification evaluation and treatment of overweight obesity in adults. Retrieved from https://www.nhlbi.nih.gov/files/docs/guidelines/ob_gdlns.pdf

National Institute of Health (NIH) (2013). Why Obesity is a health problem. Retrieved from: https://www.nhlbi.nih.gov/healthy/educational/wecan/healthy-weightbasics/obesity.htm

National Institute of Health. (2017). Confirming a high body mass index (BMI). Retrieved from https://www.nhlbi.nih.gov/health/healthtopics/topics/obe/diagnosis

Nelson, K. (2006). The burden of obesity among a national probability sample of veterans. *Journal of General Internal Medicine, 21*(9*)*, 915-919. doi:10.1111/j.1525-1497.2006. 00526. x

National Institute of Mental health (NIH). (2018). Depression. Retrieved from https://www.nimh.nih.gov/health/topics/depression/index.shtml

Obesity Action Coalition. (2018*). What is Obesity*. Retrieved from http://www.obesityaction.org/understanding-obesity/obesity

Obesity Society (2015). Your weight and diabetes. Retrieved from: https://www.obesity.org/content/weight-diabetes

Office of Minority Health. (2016). Diabetes and Hispanic Americans. Retrieved from https://minorityhealth.hhs.gov/omh/browse.aspx?lvl=4&lvlid=63

Olenick, M., Flowers, M., & Diaz, V. J. (2015). US veterans and their unique issues: enhancing health care professional awareness. *Advances in Medical Education and Practice (6)* 635-639.doi:10.2147/AMEP.S89479

Pi-Sunyer, X. (2009). The Medical Risks of Obesity. *Postgraduate Medicine*, *121*(6), 21–33. doi:10.3810/pgm.2009.11.2074

Primary Care Diabetes Prevention Program (2017). *Canada Journal of Public Health*, *2,* e176-e184.doi: 10.17269/CJPH.108.5287

Reiber, G. E., Koepsell, T. D., Maynard, C., Haas, L. B., & Boyko, E. J. (2004, May) Diabetes in nonveterans, veterans, and veterans receiving department of Veterans Affairs healthcare. *Diabetes Care 2004* (27) b3-b9. doi:10.2337/diacare.27.suppl_2.B3

Remigio-Baker, R. A., Diez Roux, A. V., Szklo, M., Crum, R. M., Leoustsakos, J., Franco, M.Golden, S. H. (2014). Physical environment may modify the association between depressive symptoms and change in waist circumference: The multi-ethnic study of atherosclerosis. *Psychosomatics*, *55*(2), 144-154. doi:10.1016/j.psym.2013.10.008

Rowley W. R, Bezold , C., Arikan, Y., & Krohe, S.(2017*). Population Health Management 20(1): 6-12 doi:10.1089/pop.2015.0181*

Rush, T., LeardMann, C. A., & Crum-Ciaflone, N. (2016). Obesity and associated adverse health outcomes among U.S military members and veterans: Findings from the millennium cohort study. *Obesity A Research Journal*, *24*(7), 1582-1589. doi:10.1002/oby.21513

Sacks-Ericsson, N., Burns, A. B., Gordon, K. H., Eckel, L. A., Wonderlich, S. A., Crosby, R. D., & Blazer, D. G. (2007). Body mass index and depressive symptoms in older adults: The moderating roles of race, sex, and socioeconomic status. *The American Journal of Geriatric Psychiatry*, *15*, 815-825. doi:10.1097/JGP.0b013e3180a725d6

Sang-wook, Y., Jae-Seok, H., Heechoul, O., & Jee-Jeon, Y. (2014). Agent Orange exposure and disease prevalence in Korean Vietnam veterans: The Korean veterans health study. *Environmental Research*, *133,* 56-65. doi: 10.1016/j.envres.2014.04.027

Sedgewick, P (2014). Cross sectional studies: Advantages and disadvantages. *The Boston Medical Journal* 348g-2276. doi: 10.1136/bmj.g2276

Schafer, S. A., Machicao, F., Fritsche, A., & Haring, H. (2011). New DM type II risk genes provide new insights in insulin secretion and mechanisms. *Diabetes Research and Clinical Practice, 93S,* S9-S24.

Selassie, M., & Sinha, A. C. (2011). The epidemiology and etiology of obesity: A global challenge. *Best Practice & research Clinical Anesthesiology*, *25*(1), 1-9. doi: 10.1016/j.bpa.2011.01.002

Seph, S., Dana, T., Blazina, I., Bougatsos, C., Patel, H., & Chou, R. (2015). Screening for type II diabetes mellitus: A systematic review for the U.S. preventive services task force. *Annals of Internal Medicine*, *162*(11), 765-776.doi:10.7326/M14-2221

Sherwani, S. I., Khan, H. A., Ekhzaimy, A., Massod, A., & Sakharkar, M. K. (2016). Significance of HbA1C test in diagnosis and prognosis of diabetic patients. *Biomarker Insights, 11*, 95-104.doi:10.4137%2FBMI.S38440

Tuomilehto, J., Lindstrom, J., Erickson, J. G., Valle, T. T., Hamalainen, H., Ilanne-Parikka, P.,... Aunola, S. (2001). Prevention of diabetes mellitus type II by changes in lifestyle among subjects with impaired glucose tolerance. *The New*

England Journal of Medicine, *344*, 1343-1350.doi: 10.1056/NEJM200105033441801

U.S. Department of Veterans Affairs Office of Research & Development. (2016). Obesity. Retrieved from https://www.research.va.gov/pubs/docs/va_factsheets/Obesity.pdf

U.S. Department of Health and Human Services. (2010). Healthy People 2020. Retrieved fromhttps://www.healthypeople.gov/sites/default/files/HP2020_brochure_with_LHI_508_FNL.pdf

U.S. Department of veterans Affairs. (2016). Research on health effects of herbicide exposure. Retrieved from https://www.publichealth.va.gov/exposures/agentorange/research-studies.asp

Veterans Authority. (2016). What is a veteran? The legal definition. Retrieved from http://va.org/what-is-a-veteran-the-legal-definition/

Veterans Health Administration. (2018). About VHA. Retrieved from https://www.va.gov/health/aboutVHA.asp

Vogelzangs, N., Kritchevsky, S. B., Beekman, A. T., Brenes, G. A., Newman, A. B., Satterfield, S., Penninx, B. W. (2010). Obesity and onset of significant depressive symptoms. *Journal of Clinical Psychiatry*, *71*(4), 391-399. doi: 10.4088/JCP.08m04743blu

Wang, Y., Beydon, M., Liang, L., Caballero, B., & Kumanyika, S. (2008). Will all Americans become overweight or obese? Estimating the progression and cost of the US obesity epidemic. *Obesity*,*16* (10) 2323-30.doi:10.1038/oby.2008.351

Wardle, J., Gibson, E., Chida, Y., Whitaker, K., & Steptoe, A. (2011). Stress and adiposity: a meta-analysis of longitudinal studies. *Obesity Silver Spring*, *19*(4), 771-778. doi:10.1038/oby.2010.241

Wiltink, J., Michal, M., Wild, P. S., Zweiner, I., Blettner, M., Munzel, T., Beutel, M. E. (2013). Associations between depression and different measures of obesity (BMI, WC, WHR, WHR .*BioMed Central*, *13*, 223. doi:10.1186/1471-244X-13-223

Yu, W., Ravelo, A., Wagner, T. H., Phibbs, C. S., Bhandari, A., Chen, S., & Barnett, P. G. (2003). Prevalence and costs of chronic conditions in the VA health care system. *Medical Care Research, 60* (3), 146s-167s.doi.org/doi:10.1177/1077558703257000

Zaccardi, F., Webb, D., Yates, T., & Davies, M. (2016). Pathophysiology of type 1 and DM type II mellitus: A90-year perspective. *BMJ*, *90(1084)*, 63-69.doi: 10.1136/postgradmedj-2015-133281